

## CLAIMS

What is claimed is:

1. A resonant optical power control device, comprising:

- a) a transmission fiber-optic waveguide for transmitting a propagating optical mode therethrough and having an evanescent optical coupling segment, an evanescent portion of the propagating optical mode extending beyond a surface of the evanescent optical coupling segment;
- b) a whispering-gallery-mode optical resonator for supporting a whispering-gallery optical mode, the whispering-gallery-mode optical resonator being positioned so that a portion of the whispering-gallery resonant optical mode at least partially spatially overlaps the evanescent portion of the propagating optical mode of the transmission fiber-optic waveguide, thereby evanescently optically coupling the transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator;
- c) a modulator optical element positioned so that an evanescent portion of the whispering-gallery optical mode at least partially spatially overlaps the modulator optical element, thereby evanescently optically coupling the whispering-gallery-mode optical resonator to the modulator optical element; and
- d) a modulator control element, operatively coupled to the modulator optical element, for modulating, in response to an applied control signal, at least one of i) a level of optical power transfer through evanescent optical coupling of the whispering-gallery-mode optical resonator and the modulator optical element, ii) a level of optical loss of the modulator optical element, and iii) a resonant frequency of the modulator optical element, thereby enabling controlled modulation of a level of transmission of the propagating optical mode through the transmission fiber-optic waveguide when the propagating optical mode is substantially resonant with the whispering-gallery optical mode.

2. A method for modulating resonant optical power transmission, comprising the steps of:  
launching a propagating optical mode into a transmission fiber-optic waveguide of a resonant optical power control device, the resonant optical power control device comprising

- a) the transmission fiber-optic waveguide, the transmission fiber-optic waveguide having an evanescent optical coupling segment, an evanescent portion of the propagating optical mode extending beyond a surface of the evanescent optical coupling segment,
  - b) a whispering-gallery-mode optical resonator for supporting a whispering-gallery resonant optical mode, the whispering-gallery-mode optical resonator being positioned so that a portion of the whispering-gallery resonant optical mode at least partially spatially overlaps the evanescent portion of the propagating optical mode of the transmission fiber-optic waveguide, thereby evanescently optically coupling the transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator,
  - c) a modulator optical element positioned so that an evanescent portion of the whispering-gallery optical mode at least partially spatially overlaps the modulator optical element, thereby evanescently optically coupling the whispering-gallery-mode optical resonator to the modulator optical element, and
  - d) a modulator control element, operatively coupled to the modulator optical element, for modulating, in response to an applied control signal, at least one of i) a level of optical power transfer through evanescent optical coupling of the whispering-gallery-mode optical resonator and the modulator optical element, ii) a level of optical loss of the modulator optical element, and iii) a resonant frequency of the modulator optical element, thereby enabling controlled modulation of a level of transmission of the propagating optical mode through the transmission fiber-optic waveguide when the propagating optical mode is substantially resonant with the whispering-gallery optical mode; and
- applying a control signal to the modulator control element to modulate the level of transmission of the propagating optical mode through the transmission fiber-optic waveguide.
3. A method for fabricating a resonant optical power control device, comprising the steps of:  
positioning a whispering-gallery-mode optical resonator relative to an evanescent optical coupling segment of a transmission fiber-optic waveguide so that a portion of a

1       whispering-gallery resonant optical mode supported by the resonator at least partially  
2       spatially overlaps an evanescent portion of a propagating optical mode transmitted by  
3       the transmission fiber-optic waveguide, thereby evanescently optically coupling the  
4       transmission fiber-optic waveguide and the whispering-gallery-mode optical resonator,  
5       the evanescent portion of the propagating optical mode extending from a surface of the  
6       evanescent optical coupling segment of the transmission fiber-optic waveguide;  
7       positioning a modulator optical element so that an evanescent portion of the whispering-  
8       gallery optical mode at least partially spatially overlaps the modulator optical element,  
9       thereby evanescently optically coupling the whispering-gallery-mode optical resonator  
10      to the modulator optical element; and  
11      operatively coupling to the modulator optical element a modulator control element for  
12      modulating, in response to an applied control signal, at least one of i) a level of optical  
13      power transfer through evanescent optical coupling of the whispering-gallery-mode  
14      optical resonator and the modulator optical element, ii) a level of optical loss of the  
15      modulator optical element, and iii) a resonant frequency of the modulator optical  
16      element, thereby enabling controlled modulation of a level of transmission of the  
17      propagating optical mode through the transmission fiber-optic waveguide when the  
18      propagating optical mode is substantially resonant with the whispering-gallery optical  
19      mode.

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